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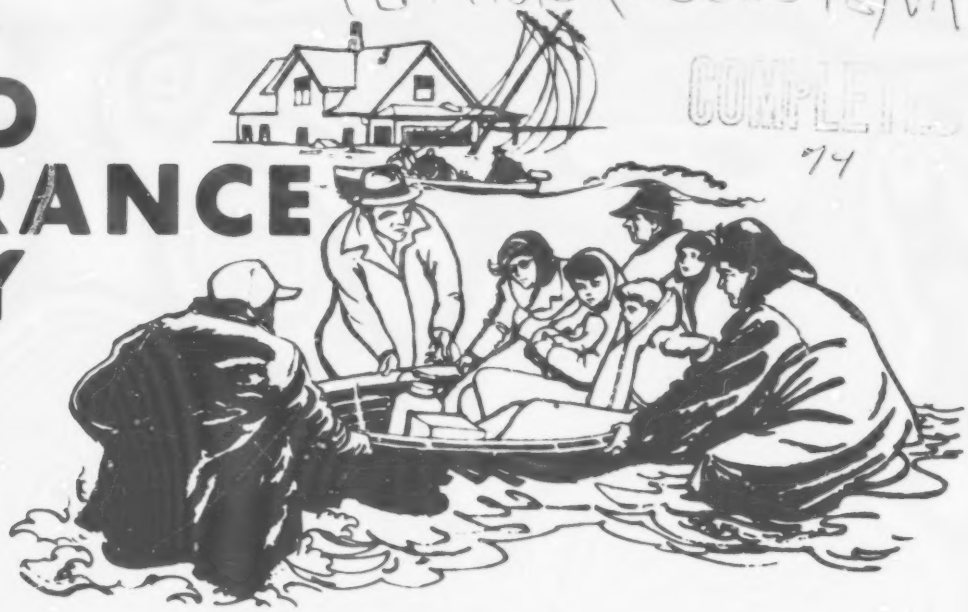
FLOOD INSURANCE STUDY



ORIGINAL

STILLWATER COUNTY, MONTANA
UNINCORPORATED AREAS
VOLUME 1 OF 2

NOVEMBER 15, 1985

Federal Emergency Management Agency

COMMUNITY NUMBER - 300078

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Flood Boundary and Floodway Map

PUBLISHED SEPARATELY:

Flood Insurance Rate Map Index
Flood Insurance Rate Map

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2.0 AREA STUDIED

2.1 Scope of Study

This Flood Insurance Study covers the unincorporated areas of Stillwater County, Montana. The area of study is shown on the Vicinity Map (Figure 1).

The level of study was determined at the local coordination meeting and was based on the amount of present or potential development and flooding problems. Only the streams that were considered to be important flooding sources were included in the study. The scope and methods of study were proposed to and agreed upon by the Federal Emergency Management Agency and Stillwater County.

Several streams in Stillwater County were studied using detailed methods. The extent to which they were studied is outlined below.

Stillwater River was studied from its confluence with Yellowstone River near Columbus upstream to the forest boundary in Section 10, T. 5 S., R. 15 E. The study reach is 31 miles.

West Fork Stillwater River was studied from its confluence with Stillwater River to the border of Custer National Forest, Section 6, T. 5 S., R. 15 E. The study reach is 7.6 miles.

Rosebud Creek was studied for 3.8 miles beginning at its confluence with Stillwater River and extending upstream to the confluence of East Rosebud Creek and West Rosebud Creek.

Sheep Creek was studied for a 1.5-mile reach upstream from its confluence with Stillwater River to Willow Street in Absarokee.

Side Channel West Fork Stillwater River was studied by detailed methods along a 1.7-mile reach.

East Rosebud Creek was studied along a 5.2-mile reach beginning at the confluence of East and West Rosebud Creeks and continuing upstream to the south line of Section 10, T. 5 S., R. 18 E. (the Stillwater-Carbon County boundary).

West Rosebud Creek was studied for 19.7 miles beginning at the confluence of East and West Rosebud Creeks and ending at the Custer National Forest boundary in Section 22, T. 6 S., R. 17 E.

Fishtail Creek was studied along an 11-mile reach beginning at its confluence with West Rosebud Creek and ending at the Custer National Forest boundary in Section 24, T. 5 S., R. 16 E.

Butcher Creek was studied along a 7-mile reach beginning at its confluence with Rosebud Creek and extending upstream to the county line in Section 6, T. 5 S., R. 19 E.

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1.0 INTRODUCTION

1.1 Purpose of Study

This Flood Insurance Study investigates the existence and severity of flood hazards in the unincorporated areas of Stillwater County, Montana, and aids in the administration of the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973. This study will be used to convert Stillwater County to the regular program of flood insurance by the Federal Emergency Management Agency. Local and regional planners will use this study in their efforts to promote sound flood plain management.

In some states or communities, flood plain management criteria or regulations may exist that are more restrictive or comprehensive than those on which these federally supported studies are based. These criteria take precedence over the minimum Federal criteria for purposes of regulating development in the flood plain, as set forth in the Code of Federal Regulations at 44 CFR, 60.3. In such cases, however, it shall be understood that the State (or other jurisdictional agency) shall be able to explain these requirements and criteria.

1.2 Authority and Acknowledgments

The source of authority for this Flood Insurance Study is the National Flood Insurance Act of 1968, as amended.

The hydrologic and hydraulic analyses for this study were performed by Morrison-Maierle, Inc., for the Federal Emergency Management Agency, under Contract No. H-4747. This work, which was completed in May 1981, covered all significant flooding sources affecting Stillwater County.

1.3 Coordination

Streams requiring detailed study and the level of study were identified at a meeting attended by representatives of Stillwater County, the Floodplain Management Section of the Montana Department of Natural Resources and Conservation, the Federal Emergency Management Agency, and the study contractor on March 28, 1978.

During the course of this study, local coordination was maintained through the Stillwater County Planning Office.

The final coordination meeting was held on July 6, 1983, and was attended by representatives of the Federal Emergency Management Agency, the study contractor, and the county.

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Fiddler Creek was studied along a 1-mile reach beginning at its confluence with West Rosebud Creek and extending upstream to the confluence of East Fork Fiddler Creek in Section 27, T. 5 S., R. 17 E.

Ingersoll Creek was studied along a 2-mile reach starting at its confluence with West Rosebud Creek and extending upstream to the county line in Section 36, T. 5 S., R. 17 E.

Those areas studied by detailed methods were chosen with consideration given to all proposed construction and forecasted development through 1986.

The Yellowstone River was studied by approximate methods along a 40-mile reach beginning at the Stillwater-Yellowstone County line in Section 35, T. 2 S., R. 23 E. and extending upstream to the Stillwater-Sweet Grass County line in Section 30, T. 1 S., R. 18 E.

Approximate analyses were used to study those areas having a low development potential or minimal flood hazards. The scope and methods of study were proposed to and agreed upon by the Federal Emergency Management Agency and Stillwater County.

2.2 Community Description

Stillwater County lies in the south-central region of Montana and covers 1,800 square miles. It is bordered by Golden Valley, Yellowstone, Carbon, Park, and Sweet Grass Counties. Columbus is both the county seat and principal town in Stillwater County. Major cities within 100 miles of Columbus include Billings, Bozeman, and Livingston.

White men first passed through Stillwater County in 1806 when William Clark and his party followed the Yellowstone River while returning from the Lewis and Clark Expedition to the northwest. Transitory hunters, trappers, and traders were the only white men to venture into the Stillwater County area until the 1860s, when trails blazed by Jim Bridger and John Bozeman brought many settlers into the area. The Northern Pacific Railroad was completed through the Yellowstone River valley in 1882 and brought an even greater influx of settlers to the area. Many farms were set up under the Homestead and Desert Lands Acts. These farms prospered until 1918, when a severe drought lasting several years caused marginal farm lands to be abandoned. Farming and ranching have continued to be Stillwater County's greatest industries and have brought many new developments to the county flood plains. In recent years, there has been an increase in the number of summer homes and residential buildings along all the streams in Stillwater County.

A large portion of the Beartooth Mountain Range in the southern end of the county contains sizable mineral deposits and is referred to as the Stillwater Complex. Mining developments in the Still-

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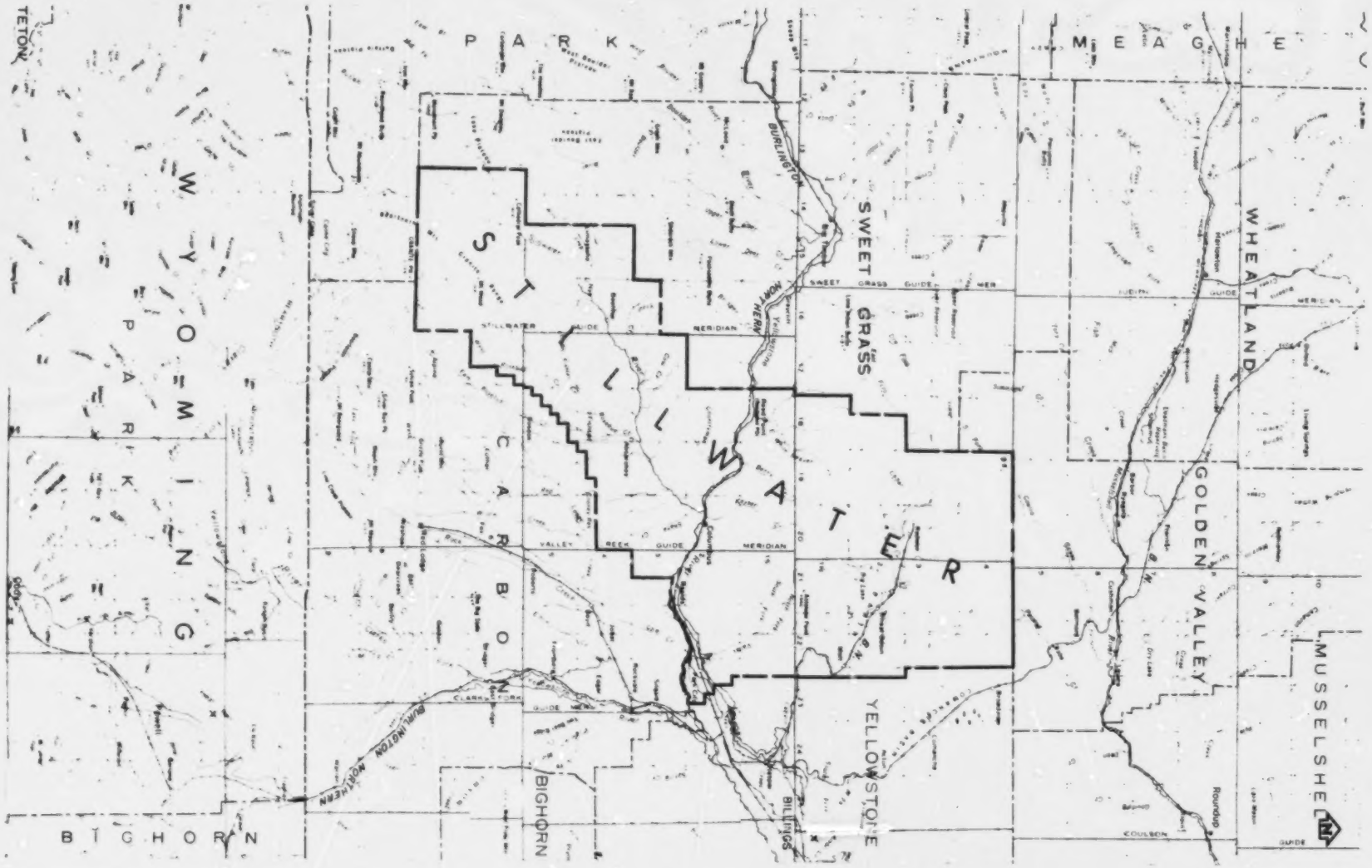

FIGURE 1

FEDERAL EMERGENCY MANAGEMENT AGENCY

STILLWATER COUNTY, MT
(UNINCORPORATED AREAS)

APPROXIMATE SCALE

16 0 16 32 48 MILES

VICINITY MAP

water Complex could bring a great influx of people into the area in the future and would require the construction of many new homes. Many of these homes might be located in the flood plains of Stillwater County.

The population of Stillwater County has been fairly constant during the last 20 years and was recorded at 5,600 in the 1980 census (Reference 1).

The Yellowstone River is the principal stream in Stillwater County and flows easterly through the central region of the county. Several small tributaries and one major one, Stillwater River, join the Yellowstone River in Stillwater County. Stillwater River originates in the Absaroka Range, located in the southern part of the county, and flows northerly to join the Yellowstone River at Columbus.

There are extreme climatic contrasts in Stillwater County due to the varied topographical features which include valley bottoms, upland plateaus, and rugged mountains. In general, the climate is characterized by moderate to strong westerly winds, low relative humidity, low seasonal precipitation, and a wide diurnal and seasonal variation of temperature. The average annual precipitation at Columbus is 14.0 inches (Reference 2). Winters are cold, with January temperatures averaging the lowest. Summers are characterized by mostly clear, warm days with temperatures rarely exceeding 95°F. The average temperatures at Columbus for January and July, respectively, are 22°F and 70°F (Reference 2).

Annual precipitation varies from 70 inches in the mountains to 12-14 inches at Yellowstone River. Much of the precipitation falls as snow at the higher elevations. Snow remains year-round on some of the mountain peaks. Accumulations have been measured to depths exceeding 20 feet, but the normal is 10 to 12 feet on the Beartooth Plateau. The melting of this snowpack during late spring and early summer contributes to the high volume of runoff in the study area drainages.

The soils of Stillwater County vary widely due to the extreme variations of parent material and topography. The topography of Stillwater County varies from rugged mountains to smooth valley bottoms. Much of the mountainous area is above timberline and consists of jagged peaks and basins formed by glaciers. Undifferentiated alluvial soils are generally found on the flood plains and high bottomlands of the stream valleys. These soils have poor to moderate infiltration rates, a fair accumulation of organic matter and yield good crops. The soils of the uplands have generally developed from shale or sandstone parent materials. Soils developed on the lighter textured shales and sandstone parent material break into soft irregular aggregates when wet and have moderate infiltration rates. The upland soils developed on the heavy shales are

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clayey and have no structure. They are hard and compact when dry and sticky plastic when wet. These soils have very low infiltration rates. The soils in the mountainous regions have developed on igneous, metamorphic, and sedimentary rocks and are widely varied. These soils are generally shallow, have low to moderate infiltration rates, and are a poor accumulation of organic matter.

Mineral resources in Stillwater County include gold, silver, copper, chromite, and coal. There are significant quantities of these resources available but little production of them has taken place.

2.3 Principal Flood Problems

Heavy spring rains in conjunction with snowmelt runoff have caused the major floods in Stillwater County. The headwaters of most streams studied lie at high altitudes and can accumulate heavy winter snowpacks. Streamflows are typically at their lowest during the winter and increase steadily during the spring as warmer temperatures, sometimes augmented by rainfall, begin to melt the snowpack. Major floods are usually preceded by a warm, moist winter which produces a heavy snowpack and lingers late into the spring. The floods are then triggered by a major Pacific storm which brings warm temperatures and heavy rain.

Ice jams occur at random sites with no predictable pattern and therefore are very difficult to quantify. This study did not take ice-jam effects into account because the location, magnitude, and frequency of ice-jam effects are impossible to predict at this time.

The majority of the flood damage which has occurred in Stillwater County has been caused by encroachment on the flood plain by residential construction, farm buildings and fences, irrigation diversions, dikes, and roads (Figures 2-7). Many recreational and year-round homes are located on the river flood plain. Some of these homes are inundated by common high-water events, while others are well above the 100-year flood plain.

The U.S. Geological Survey (USGS) maintains a stream gaging station on Stillwater River near Absarokee. Major floods were recorded at this site in 1967, 1974, and 1975. The recurrence intervals for the floods were 70 years (12,000 cubic feet per second (cfs)), 50 years (11,600 cfs), and 45 years (11,300 cfs), respectively. The majority of the tributaries to Stillwater River do not have gaging sites, but probably experienced floods of a similar recurrence interval during the high-water years of 1967, 1974, and 1975. These floods caused widespread damage to residences, farm buildings, bridges, and summer homes throughout Stillwater County.

The 1974 Yellowstone River flood was a 75-year event at the Corwin Springs gaging station (No. 06191500) and a 35-year event at the

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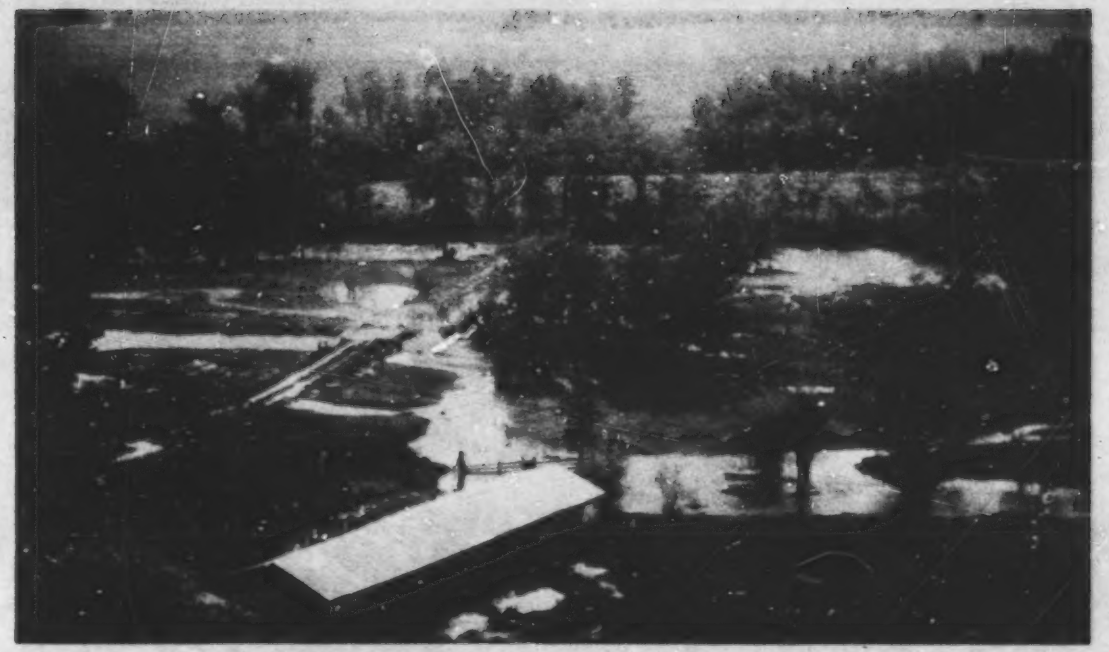

Figure 2. High Water in June 1967 Along West Rosebud Creek (Note how overflow occurs in side channels and on low flood plain areas.)

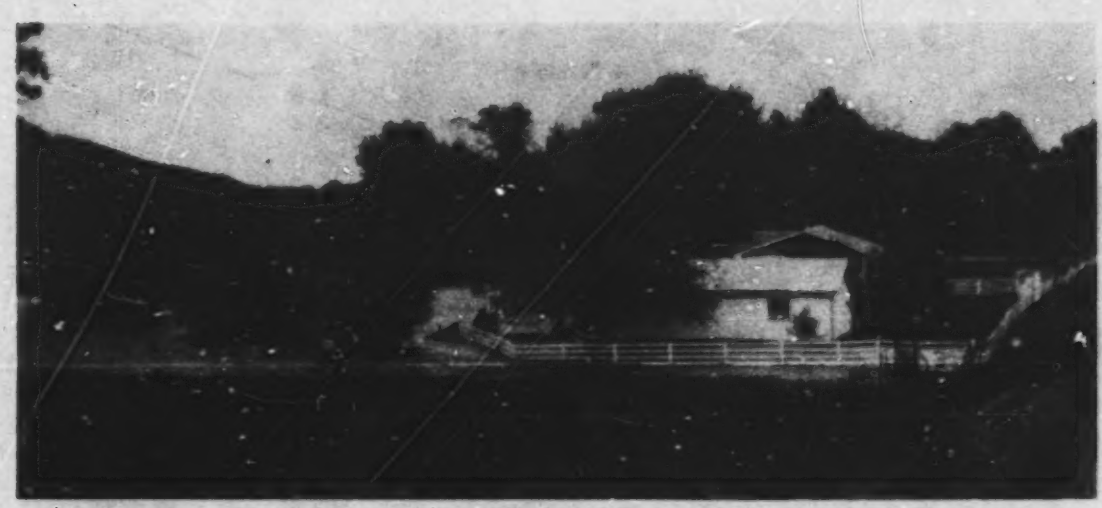

Figure 3. High Water Along Fishtail Creek Endangers Many Buildings

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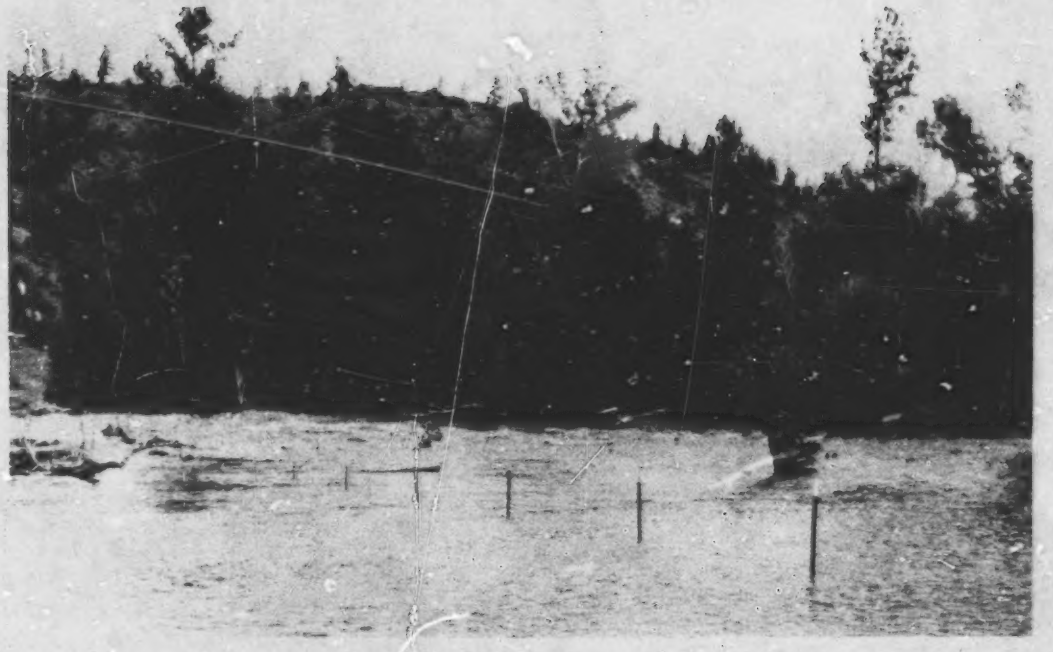

Figures 4 and 5. Many Summer Homes Have Been Built in a Flood Plain Area That is Frequently Flooded (Compare photo above with later photo below. Many buyers of flood plain property are often unaware of these hazards.)

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Figure 6. June 1967 Floodwater Damages Farm Buildings and Fences on Butcher Creek (Bank erosion, as shown above, contributes to downstream sediment damages.)

Figure 7. Floodwater From Butcher Creek Flows Onto Rosebud Creek Flood Plain (Smith Bridge on Rosebud Creek is shown in the background.)

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Billings gaging station (No. 06214500). The study reaches in Stillwater County are approximately 35 miles from Billings, and adjusting the 1974 flood recurrence interval between the two sites yields a flood recurrence of approximately 40 years along the Stillwater County study reaches. The flood peak in Corwin Springs occurred on June 17, 1974, and the flood peak at Billings occurred on June 19, 1974. The Montana Department of Highways flood photos were taken on June 18, 1974, and coincide with the Yellowstone River flood peak in Stillwater County. The flood peak at both gaging sites lasted 3 to 4 days, and the area inundated would not have looked significantly different if the photographs had been taken a day earlier or day later.

2.4 Flood Protection Measures

Flood protection measures in Stillwater County are limited and include no major structures. Large riprap lines the east bank of Rosebud Creek through Absarokee, providing bank stabilization in an area where high stream velocities occur.

Several small flood protection measures are scattered throughout the study area, including small dikes, retaining walls, and railroad and highway embankments. The railroad and highway embankments will act as levees in some areas, but will not provide complete flood protection due to the transfer of floodwater through drainage structures which will cause ponding behind the embankments.

3.0 ENGINEERING METHODS

For the flooding sources studied in detail in the county, standard hydrologic and hydraulic study methods were used to determine the flood hazard data required for this study. Flood events of a magnitude which are expected to be equaled or exceeded once on the average during any 10-, 50-, 100-, or 500-year period (recurrence interval) have been selected as having special significance for flood plain management and for flood insurance premium rates. These events, commonly termed the 10-, 50-, 100-, and 500-year floods, have a 10, 2, 1, and 0.2 percent chance, respectively, of being equaled or exceeded during any year. Although the recurrence interval represents the long term average period between floods of a specific magnitude, rare floods could occur at short intervals or even within the same year. The risk of experiencing a rare flood increases when periods greater than 1 year are considered. For example, the risk of having a flood which equals or exceeds the 100-year flood (1 percent chance of annual occurrence) in any 50-year period is approximately 40 percent (4 in 10), and, for any 90-year period, the risk increases to approximately 60 percent (6 in 10). The analyses reported here reflect flooding potentials based on conditions existing in the county at the time of completion of this study. Maps and flood elevations will be amended periodically to reflect future changes.

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3.1 Hydrologic Analyses

Hydrologic analyses were carried out to establish the peak discharge-frequency relationships for floods of the selected recurrence intervals for each flooding source studied in detail affecting the county.

The work developed by the U.S. Soil Conservation Service (SCS) and used in three flood hazard reports for Stillwater County was reviewed and updated, as explained in the following paragraphs, for use in this Flood Insurance Study.

Stillwater River

The hydrology developed by the SCS and used in their Flood Hazard Analyses reports (References 3 and 4) for Stillwater River was based on gaging station records from sites near Nye and Absarokee. This hydrology agreed with the hydrology used in this report for the Stillwater River tributaries. The gaging station near Absarokee (No. 0625000) has been in continuous operation since 1935 and provides a long-term record. The gaging station near Nye was operated from October 1969 to January 1977. During the 7 years of record, two very high flow years, 1974 and 1975, were recorded. The station record at Nye was too short for a dependable log-Pearson analysis and the SCS developed a relationship using the station at Absarokee to correlate and extend the record at Nye. A log-Pearson analysis of the actual records from the Absarokee station and the extended records from the Nye station were used to develop drainage area-discharge curves for the selected recurrence intervals. These curves were used to establish the flood peaks on the Lower, Upper, and West Forks Stillwater River.

Stillwater River Tributaries

There are no historic streamflow records on the detailed-study streams of the Stillwater River tributaries with the exception of one site on West Rosebud Creek. The USGS maintains a gage just below the Mystic Lake powerhouse on West Rosebud Creek. This gage is located on the upper end of the West Rosebud Creek basin and reflects the regulation effects of Mystic Lake. This gage is not typical of the surrounding unregulated streams and could not be used to predict floods on those streams. Therefore, a regional analysis technique was used to determine peak floodflows on the Stillwater River tributaries. The Stillwater River tributaries include East and West Rosebud Creeks, Fishtail Creek, Fiddler Creek, Sheep Creek, Ingersoll Creek, and Butcher Creek. This regional analysis technique related flood magnitudes to watershed drainage areas and utilized long-term, continuous flow records from 13 sites within the Upper Yellowstone River basin and in the vicinity of Stillwater County. The station records used for the regional analysis are summarized in Table 1.

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Table 1. Gaging Stations in Stillwater County and Adjoining Areas

Station	Drainage Area (Square Miles)	USGS Station No.	Years of Record
Lamar River near Tower Falls	660.0	06188000	47
Boulder River at Contact	226.0	06197500	31
Stillwater River near Absarokee	975.0	06205000	47
Rock Creek near Red Lodge	124.0	06209500	46
Willow Creek near Boyd	53.3	06211500	42
Rosebud Creek near Absarokee	394.0	06204500	35
West Wets Creek near Billings	8.8	06216200	24
Bridger Creek near Greycliff	61.5	06201600	16
W. Buckeye Creek near Billings	2.64	06216300	20
Clarks Fork near Silesia	2,093.0	06208500	56
Boulder River at Big Timber	523.0	06200000	31
Sweetgrass Creek near Melville	64.0	06200500	45

These records were analyzed to determine 10-, 50-, 100-, and 500-year flows using log-Pearson Type III distributions and skews from U.S. Water Resources Council Bulletin 17A (Reference 5). Two regression analyses were performed correlating log-Pearson flows and the station drainage areas; and log-Pearson flows and the station drainages areas, channel slope, and average annual precipitation. The drainage area parameter is the most significant variable for predicting flood peaks and was used for this analysis. An exponential equation provided the best agreement of the data with correlation coefficients (R) ranging from 0.93 to 0.96 for 10-, 50-, and 100-year flood peaks. The equation used is of the form:

$$Q_t = a\,A^b$$

where: Q_t = floodflow with t-year recurrence (cfs)

a = regression constant

b = coefficient defined by regression analysis

A = drainage area (square miles).

The final equations derived from the regression analysis are:

$$Q_{10} = 97(A)^{.643}$$

$$Q_{50} = 283(A)^{.533}$$

$$Q_{100} = 417(A)^{.489}$$

$$Q_{500} = .933(A)^{.399}$$

Discharges computed for the input stations using the preceding regression equations were compared with the log-Pearson Type III analysis of the input stations and checked within acceptable limits.

Peak discharge-drainage area relationships for each stream studied in detail are shown in Table 2.

3.2 Hydraulic Analyses

Analyses of the hydraulic characteristics of the flooding sources studied in the county were carried out to provide estimates of the elevations of floods of the selected recurrence intervals along each of these flooding sources.

The hydraulic characteristics of each stream studied in detail were analyzed to provide estimates of the elevations of the 10-,

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Table 2. Summary of Discharges

Flooding Source and Location	Drainage Area (Square Miles)	Peak Discharges (Cubic Feet per Second) 10-Year	50-Year	100-Year	500-Year
Stillwater River					
At Confluence with Yellowstone River	1,057	8,870	11,550	12,690	15,680
Upstream of Confluence with Rosebud Creek	525	8,200	10,400	11,200	13,500
West Fork Upper Stillwater River					
At Confluence with Stillwater River	110	1,650	2,150	2,350	2,850
Side Channel West Fork Stillwater River					
At Confluence with Stillwater River	transfer	N/A	60	110	320
Rosebud Creek					
At Confluence with Stillwater River	420	4,868	6,916	7,827	10,209
West Rosebud Creek					
At Confluence with East Rosebud and Rosebud Creeks	209.2	3,178	4,883	5,687	7,867
Sheep Creek					
At Grove Street	transfer	45	75	125	350
East Rosebud Creek					
At Confluence with West Rosebud and Rosebud Creeks	184.9	2,931	4,572	5,354	7,488
Fiddler Creek					
At Confluence with West Rosebud Creek	28.0	855	1,672	2,127	3,526
Fishtail Creek					
At Confluence with West Rosebud Creek	61.5	1,429	2,542	3,125	4,827
Ingersoll Creek					
At Confluence with West Rosebud Creek	9.4	419	934	1,247	2,281
Butcher Creek					
At Confluence with East Rosebud Creek	39.0	1,061	1,994	2,501	4,025

50-, 100-, and 500-year floods. Flood elevations were computed with the SCS WSP-2 or HUD-15 computer programs (References 6 and 7) and the U.S. Army Corps of Engineers HEC-2 computer program (Reference 8).

Cross sections for the backwater analyses were established by field survey and located at all bridges and culverts in order to establish the possible backwater effect. Locations of selected cross sections used in the hydraulic analyses are shown on the Flood Profiles (Exhibit 1). For stream segments for which a floodway is computed (Section 4.2), selected cross section locations are also shown on the Flood Boundary and Floodway Map (Exhibit 2).

Roughness factors (Mannings "n") values for the hydraulic analyses were assigned on the basis of field observation and aerial photographs (References 3, 4, 9, and 10). The Mannings "n" values used in this study are presented below.

Stream	Channel "n"	Overbank "n"
Stillwater River	0.023-0.09	0.09-0.30
West Fork Stillwater River	0.02 -0.065	0.10-0.30
Rosebud Creek	0.05 -0.06	0.05-0.08
Sheep Creek	0.05	0.08
East Rosebud Creek	0.055-0.06	0.07-0.30
West Rosebud Creek	0.055-0.08	0.08-0.30
Butcher Creek	0.04 -0.06	0.10-0.30
Fishtail Creek	0.06 -0.20	0.06-0.30
Fiddler Creek	0.08 -0.10	0.15-0.30
Ingersoll Creek	0.10	0.15-0.30

Starting water-surface elevations for all streams were developed by the slope-area method.

Flood profiles were drawn showing computed water-surface elevations to an accuracy of 0.5 foot for floods of the selected recurrence intervals (Exhibit 1).

The hydraulic analyses reflect unobstructed flow. Therefore, flood elevations shown on the profiles are considered valid only if bridges and culverts remain unobstructed by flood-borne debris. A division of flow occurs on West Fork Stillwater River between cross section I and the Stillwater River main stem. Flow will be transferred into this side channel whenever floods equal or exceed the 50-year recurrence on the West Fork and separate profiles have been provided for this reach.

Sheep Creek is normally used to convey irrigation water which is diverted into the channel from Rosebud Creek at a point 1.5 miles south of Absarokee. The Sheep Creek channel does not run

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near Rosebud Creek after the diversion until it reaches Willow Street in Absarokee. Between Willow Street and School Street, the Sheep Creek channel runs along the right bank of Rosebud Creek. There is a measurement device and a check structure located at the end of Willow Street. The left bank of Sheep Creek, from Willow Street to a point approximately 200 feet downstream, is low enough to allow floodwater from the 10-, 50-, 100-, and 500-year floods on Rosebud Creek to overtop and enter the Sheep Creek channel. The floodflow that will enter Sheep Creek and continue through town is controlled by the culvert under School Street and roadway elevations along School Street.

Downstream of School Street, the 10- and 50-year floodflows in Sheep Creek will be contained within the channel and will not result in extensive flooding problems provided that the culverts remain clear. The 100-year flood will exceed the capacity of all but the Grove Street structure and cause localized ponding and sheet flooding along the Sheep Creek channel. The 500-year floodflow from the Rosebud Creek overflow near Willow Street greatly exceeds the capacity of the Sheep Creek channel and structures. The Grove Street bridge restricts the 500-year floodflows on Rosebud Creek and results in a backwater which will allow a second overflow into Sheep Creek along the divide above Grove Street which separates the two channels.

All elevations are referenced to the National Geodetic Vertical Datum of 1929 (NGVD). Elevation reference marks used in the study are shown on the maps.

4.0 FLOOD PLAIN MANAGEMENT APPLICATIONS

The National Flood Insurance Program encourages State and local governments to adopt sound flood plain management programs. Therefore, each Flood Insurance Study includes a flood boundary map designed to assist communities in developing sound flood plain management measures.

4.1 Flood Boundaries

In order to provide a national standard without regional discrimination, the 100-year flood has been adopted by the Federal Emergency Management Agency as the base flood for purposes of flood plain management measures. The 500-year flood is employed to indicate additional areas of flood risk in the community. For each stream studied in detail, the boundaries of the 100- and 500-year floods have been delineated using the flood elevations determined at each cross section; between cross sections, the boundaries were interpolated using topographic maps at a scale of 1:24,000, with a contour interval of 20 feet (References 11 and 12), or developed photogrammetrically, using aerial photographs at a scale of 1:16,000 (Reference 13).

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Approximate flood boundaries in some portions of the study area were taken from the Flood Hazard Boundary Map (Reference 14).

Additional approximate flood boundaries were delineated using quadrangle maps and aerial photographs (References 10, 11, 12, and 13). Aerial photographs of the June 1974 Yellowstone River flood were obtained from the Montana Department of Highways (Reference 13) and used to verify or redelineate the USGS flood-prone quadrangles (Reference 11). These quadrangles were published in 1972 and delineated without the benefit of aerial flood photographs; therefore, the 1974 flood photographs improved the detail of those delineations.

Flood boundaries for the 100- and 500-year floods are shown on the Flood Boundary and Floodway Map (Exhibit 2). In cases where the 100- and 500-year flood boundaries are close together, only the 100-year flood boundary has been shown. Small areas within the flood boundaries may lie above the flood elevations and, therefore, not be subject to flooding; owing to limitations of the map scale, such areas are not shown.

4.2 Floodways

Encroachment on flood plains, such as artificial fill, reduces the flood-carrying capacity, increases the flood heights of streams, and increases flood hazards in areas beyond the encroachment itself. One aspect of flood plain management involves balancing the economic gain from flood plain development against the resulting increase in flood hazard. For purposes of the National Flood Insurance Program, the concept of a floodway is used as a tool to assist local communities in this aspect of flood plain management. Under this concept, the area of the 100-year flood is divided into a floodway and a floodway fringe. The floodway is the channel of a stream plus any adjacent flood plain areas that must be kept free of encroachment in order that the 100-year flood may be carried without substantial increases in flood heights. Minimum standards of the Federal Emergency Management Agency limit such increases in flood heights to 1.0 foot, provided that hazardous velocities are not produced. The floodways in this report are presented to local agencies as minimum standards that can be adopted or that can be used as a basis for additional studies.

In the State of Montana the standards are more restrictive. The Montana Administration Code 36-2, 14B(2)S14Z, FLOODWAY DELINEATION, Section 89-3501(1) of Revised Code of Montana, 1947, states that:

> The delineation of a designated floodway shall be based on the channel of the watercourse or drainway and those portions of the adjoining flood plain which are reasonably required to carry the discharge of the flood of 100-year frequency without any theoretical measurable increase in

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flood heights. In areas having appreciable urban development on the flood plain, the outer boundary lines of the floodway may generally follow the riverward limits of development provided that:

(a) The calculated elevation of the flood of one hundred (100) year frequency would not be increased more than five-tenths (0.5) foot as a result of the theoretical additional construction of the floodway; (b) Floodway lines are compatible with local land-use plans; (c) The flood fringe does not contain appreciable areas with flood velocities greater than three (3) feet; and (d) After the delineation of a suggested designated floodway by the Department, and prior to the public hearing to consider the floodway delineations, the Department shall meet with local governmental and planning officials to consider possible adjustments due to local land-use consideration. No adjustments in floodway width or location may be made, however, if such adjustments would theoretically increase flood heights beyond the permissible limits noted in subsection (1) of this section.

On the Side Channel West Fork Stillwater River, no floodway was designated.

The floodways presented in this study were computed on the basis of equal-conveyance reduction from each side of the flood plain. The results of these computations are tabulated at selected cross sections for each stream segment for which a floodway was computed (Table 3).

As shown on the Flood Boundary and Floodway Map (Exhibit 2), the floodway widths were determined at cross sections; between cross sections, the boundaries were interpolated. In cases where the boundaries of the floodway and the 100-year flood are either close together or collinear, only the floodway boundary has been shown.

The area between the floodway and the boundary of the 100-year flood is termed the floodway fringe. The floodway fringe thus encompasses the portion of the flood plain that could be completely obstructed without increasing the water-surface elevation of the 100-year flood more than 0.5 foot at any point. Typical relationships between the floodway and the floodway fringe and their significance to flood plain development are shown in Figure 8.

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FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
					(FEET NGVD)			
Butcher Creek								
A	1,300	157	2,260	1.1	4,201.1	4,201.1	4,201.6	0.5
B	2,400	85	373	6.7	4,211.1	4,211.1	4,211.6	0.5
C	2,900	286	812	3.1	4,221.8	4,221.8	4,222.3	0.5
D	5,000	314	907	2.8	4,235.8	4,235.8	4,236.3	0.5
E	7,240	315	1,031	2.4	4,266.1	4,266.1	4,266.6	0.5
F	9,240	324	1,085	2.3	4,286.6	4,286.6	4,287.1	0.5
G	12,240	716	1,386	1.8	4,307.6	4,307.6	4,308.1	0.5
H	14,720	206	751	3.3	4,330.9	4,330.9	4,331.4	0.5
I	18,300	458	947	2.6	4,352.7	4,352.7	4,353.2	0.5
J	22,040	253	989	2.5	4,371.8	4,371.8	4,372.3	0.5
K	25,950	155	861	2.9	4,387.8	4,387.8	4,388.3	0.5
L	31,570	118	590	4.2	4,413.6	4,413.6	4,414.1	0.5
M	35,400	365	1,388	1.8	4,434.5	4,434.5	4,435.0	0.5

[1]Feet Above Confluence With East Rosebud Creek

TABLE 3

FEDERAL EMERGENCY MANAGEMENT AGENCY

STILLWATER COUNTY, MT
(UNINCORPORATED AREAS)

FLOODWAY DATA

BUTCHER CREEK

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FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
					(FEET NGVD)			
East Rosebud Creek								
A	1,020	632	1,824	2.9	4,195.2	4,195.2	4,195.7	0.5
B	1,480	285	704	6.8	4,203.4	4,203.4	4,203.9	0.5
C	1,560	366	1,534	3.1	4,206.0	4,206.0	4,206.5	0.5
D	3,000	122	715	6.7	4,222.9	4,222.9	4,223.4	0.5
E	5,100	731	2,711	1.8	4,253.6	4,253.6	4,254.1	0.5
F	8,700	767	1,949	2.4	4,295.3	4,295.3	4,295.8	0.5
G	11,460	452	825	5.8	4,333.3	4,333.3	4,333.8	0.5
H	14,340	286	1,138	4.2	4,368.0	4,368.0	4,368.5	0.5
I	17,000	123	598	8.0	4,412.8	4,412.8	4,413.3	0.5
J	19,360	437	1,489	3.2	4,446.6	4,446.6	4,447.1	0.5
K	21,260	356	1,108	4.1	4,470.6	4,470.6	4,471.1	0.5
L	21,340	111	750	6.1	4,474.3	4,474.3	4,474.8	0.5
M	23,080	133	846	5.4	4,496.0	4,496.0	4,496.5	0.5
N	25,600	253	1,341	3.4	4,528.0	4,528.0	4,528.5	0.5
O	26,500	381	1,098	4.2	4,540.7	4,540.7	4,541.2	0.5
P	26,600	410	817	5.6	4,542.1	4,542.1	4,542.6	0.5
Q	27,260	258	853	5.4	4,549.1	4,549.1	4,549.6	0.5

[1]Feet Above Confluence With West Rosebud Creek and Rosebud Creek

TABLE 3

FEDERAL EMERGENCY MANAGEMENT AGENCY

STILLWATER COUNTY, MT
(UNINCORPORATED AREAS)

FLOODWAY DATA

EAST ROSEBUD CREEK

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
					(FEET NGVD)			
Fiddler Creek								
A	395	62	238	8.9	5,066.3	5,066.3	5,066.8	0.5
B	460	94	530	4.0	5,071.0	5,071.0	5,071.5	0.5
C	2,940	120	537	4.0	5,089.7	5,089.7	5,090.2	0.5
D	5,650	125	574	3.7	5,117.2	5,117.2	5,117.7	0.5
E	7,175	62	426	5.0	5,134.2	5,134.2	5,134.7	0.5
F	7,350	303	1,343	1.6	5,136.5	5,136.5	5,137.0	0.5
G	8,500	75	488	4.4	5,151.2	5,151.2	5,151.7	0.5
H	9,360	68	284	4.2	5,168.6	5,168.6	5,169.1	0.5

[1] Feet Above Confluence With West Rosebud Creek

TABLE 3

FEDERAL EMERGENCY MANAGEMENT AGENCY

STILLWATER COUNTY, MT
(UNINCORPORATED AREAS)

FLOODWAY DATA

FIDDLER CREEK

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FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
					(FEET NGVD)			
Fishtail Creek								
A	1,300	67	495	6.3	4,394.9	4,387.2[2]	4,387.7[2]	0.5
B	1,950	120	685	4.6	4,398.0	4,395.3[2]	4,395.8[2]	0.5
C	3,000	232	775	4.0	4,409.2	4,409.2	4,409.7	0.5
D	5,500	142	628	5.0	4,434.2	4,434.2	4,434.7	0.5
E	7,150	313	974	3.2	4,451.1	4,451.1	4,451.6	0.5
F	8,550	388	1,022	3.1	4,462.0	4,462.0	4,462.5	0.5
G	10,290	235	1,083	2.9	4,475.5	4,475.5	4,476.0	0.5
H	14,480	389	1,401	2.2	4,505.8	4,505.8	4,506.3	0.5
I	14,700	515	1,391	2.2	4,506.6	4,506.6	4,507.1	0.5
J	17,200	564	1,572	2.0	4,532.2	4,532.2	4,532.7	0.5
K	17,350	536	1,235	2.5	4,533.6	4,533.6	4,534.1	0.5
L	18,700	246	1,200	2.6	4,546.5	4,546.5	4,547.0	0.5
M	18,980	164	674	4.6	4,547.5	4,547.5	4,548.0	0.5
N	20,920	152	885	3.5	4,573.7	4,573.7	4,574.2	0.5
O	23,000	122	512	6.1	4,596.4	4,596.4	4,596.9	0.5
P	27,360	190	738	4.2	4,636.9	4,636.9	4,637.4	0.5
Q	27,780	105	485	6.4	4,641.6	4,641.6	4,642.1	0.5
R	30,070	280	1,304	2.4	4,667.2	4,667.2	4,667.7	0.5
S	33,900	396	1,156	2.7	4,694.4	4,694.4	4,694.9	0.5
T	35,550	413	1,470	2.1	4,719.5	4,719.5	4,720.0	0.5
U	37,400	473	1,228	2.5	4,738.4	4,738.4	4,738.9	0.5
V	40,790	294	1,042	3.0	4,767.8	4,767.8	4,768.3	0.5
W	43,900	109	402	7.8	4,811.9	4,811.9	4,812.4	0.5
X	47,240	68	413	7.6	4,852.8	4,852.8	4,853.3	0.5
Y	48,960	145	611	5.1	4,876.8	4,876.8	4,877.3	0.5
Z	51,100	226	1,083	2.3	4,913.6	4,913.6	4,914.1	0.5

[1]Feet Above Confluence With West Rosebud Creek

[2]Elevation Computed Without Consideration of Effects From West Rosebud Creek

TABLE 3

FEDERAL EMERGENCY MANAGEMENT AGENCY

STILLWATER COUNTY, MT
(UNINCORPORATED AREAS)

FLOODWAY DATA

FISHTAIL CREEK

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
					(FEET NGVD)			
Fishtail Creek (Cont'd)								
AA	55,010	96	383	6.4	4,977.7	4,977.7	4,978.2	0.5
AB	57,860	283	701	3.5	5,024.7	5,024.7	5,025.2	0.5
AC	59,580	330	806	3.0	5,053.3	5,053.3	5,053.8	0.5
AD	60,700	146	560	4.4	5,078.1	5,078.1	5,078.6	0.5
AE	61,100	90	417	5.9	5,088.1	5,088.1	5,088.6	0.5
AF	62,240	165	470	4.6	5,114.2	5,114.2	5,114.7	0.5
AG	63,570	186	705	3.0	5,143.4	5,143.4	5,143.9	0.5
AH	66,500	464	875	2.5	5,230.6	5,230.6	5,231.1	0.5
AI	69,880	332	847	2.5	5,319.8	5,319.8	5,320.3	0.5
AJ	71,800	130	732	2.9	5,377.0	5,377.0	5,377.5	0.5
AK	72,430	90	548	3.9	5,398.2	5,398.2	5,398.7	0.5
AL	72,890	176	584	3.7	5,417.6	5,417.6	5,418.1	0.5
AM	75,000	307	1,667	1.3	5,505.5	5,505.5	5,506.0	0.5

[1]Feet Above Confluence With West Rosebud Creek

TABLE 3

FEDERAL EMERGENCY MANAGEMENT AGENCY

STILLWATER COUNTY, MT
(UNINCORPORATED AREAS)

FLOODWAY DATA

FISHTAIL CREEK

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FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
					(FEET NGVD)			
Ingersoll Creek								
A	220	114	547	2.3	4,824.0	4,823.8[2]	4,824.3[2]	0.5
B	1,857	58	273	4.6	4,849.7	4,849.7	4,849.7	0.0
C	3,143	64	321	3.9	4,873.2	4,873.2	4,873.7	0.5
D	4,979	323	1,037	1.2	4,888.3	4,888.3	4,888.8	0.5
E	7,410	73	600	2.1	4,925.4	4,925.4	4,925.9	0.5
F	8,102	58	398	3.1	4,938.4	4,938.4	4,938.9	0.5
G	9,952	175	662	1.9	4,954.1	4,954.1	4,954.6	0.5
H	11,197	59	469	2.7	4,961.8	4,961.8	4,962.3	0.5
I	15,062	77	413	3.0	4,997.2	4,997.2	4,997.7	0.5
J	17,412	63	440	2.8	5,021.0	5,021.0	5,021.3	0.3
K	20,097	100	596	2.1	5,050.4	5,050.4	5,050.7	0.3
L	23,917	92	528	2.4	5,087.5	5,087.5	5,087.8	0.3

[1]Feet Above Confluence With West Rosebud Creek

[2]Elevations Computed Without Consideration of Backwater Effects From West Rosebud Creek

TABLE 3

FEDERAL EMERGENCY MANAGEMENT AGENCY

STILLWATER COUNTY, MT
(UNINCORPORATED AREAS)

FLOODWAY DATA

INGERSOLL CREEK

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
					(FEET NGVD)			
Rosebud Creek								
A	600	155	901	8.6	3,986.7	3,986.7	3,986.7	0.0
B	2,550	250	871	8.8	4,007.1	4,007.1	4,007.3	0.2
C	4,650	95	731	10.5	4,028.1	4,028.1	4,028.4	0.3
D	4,770	104	816	9.4	4,032.7	4,032.7	4,032.7	0.0
E	5,600	188	1,180	6.5	4,039.2	4,039.2	4,039.2	0.0
F	6,750	244	798	9.7	4,050.0	4,050.0	4,050.1	0.1
G	7,755	405	1,651	4.7	4,058.6	4,058.6	4,059.1	0.5
H	9,985	175	689	11.4	4,083.1	4,083.1	4,083.1	0.0
I	12,805	425	1,871	4.2	4,107.8	4,107.8	4,108.2	0.4
J	14,895	318	779	10.0	4,129.2	4,129.2	4,129.2	0.0
K	16,955	344	1,589	4.9	4,151.8	4,151.8	4,152.3	0.5
L	19,255	298	958	8.2	4,176.5	4,176.5	4,176.5	0.0
M	19,405	483	2,672	2.9	4,180.3	4,180.3	4,180.3	0.0
N	19,855	205	731	10.7	4,181.4	4,181.4	4,181.9	0.5
Sheep Creek								
A	2,950	20	35	3.6	3,987.3	3,987.3	3,987.6	0.3
B	4,550	16	37	3.4	4,007.2	4,007.2	4,007.6	0.4
C	5,790	8	21	6.1	4,016.1	4,016.1	4,016.6	0.5
D	6,690	35	71	1.8	4,028.4	4,028.4	4,028.5	0.1
E	6,810	50	123	1.0	4,028.9	4,028.9	4,029.1	0.2
F	7,870	10	30	4.1	4,040.8	4,040.8	4,040.8	0.0
G	8,400	51	90	1.4	4,042.7	4,042.7	4,042.9	0.2
H	9,000	23	39	3.2	4,047.4	4,047.4	4,047.4	0.0

[1] Feet Above Confluence With Stillwater River

TABLE 3

FEDERAL EMERGENCY MANAGEMENT AGENCY

STILLWATER COUNTY, MT
(UNINCORPORATED AREAS)

FLOODWAY DATA

ROSEBUD CREEK-SHEEP CREEK

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FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
					(FEET NGVD)			
Stillwater River								
A	3,370	1,271	2,480	5.12	3,595.0	3,595.0	3,595.5	0.5
B	5,633	761	2,227	5.70	3,607.5	3,607.5	3,608.0	0.5
C	7,350	300	1,583	8.02	3,617.3	3,617.3	3,617.8	0.5
D	8,110	190	1,280	9.90	3,624.0	3,624.0	3,624.5	0.5
E	8,210	300	2,296	5.53	3,624.7	3,624.7	3,625.2	0.5
F	9,170	215	1,388	9.14	3,629.6	3,629.6	3,630.1	0.5
G	10,250	472	1,665	7.62	3,636.3	3,636.3	3,636.8	0.5
H	11,554	286	1,632	7.78	3,644.2	3,644.2	3,644.7	0.5
I	12,550	250	1,568	8.09	3,649.4	3,649.4	3,649.9	0.5
J	14,632	364	1,535	8.27	3,663.4	3,663.4	3,663.9	0.5
K	15,432	413	1,568	8.09	3,669.0	3,669.0	3,669.5	0.5
L	17,038	368	1,762	7.15	3,677.8	3,677.8	3,678.3	0.5
M	18,640	210	1,416	8.90	3,685.4	3,685.4	3,685.9	0.5
N	20,487	175	1,200	10.60	3,696.1	3,696.1	3,696.6	0.5
O	22,802	421	1,940	6.49	3,709.1	3,709.1	3,709.6	0.5
P	25,074	1,126	1,418	8.89	3,725.3	3,725.3	3,725.8	0.5
Q	25,274	1,000	2,335	5.40	3,726.9	3,726.9	3,727.4	0.5
R	25,434	713	2,046	6.16	3,728.6	3,728.6	3,729.1	0.5
S	27,432	600	1,897	6.64	3,741.5	3,741.5	3,742.0	0.5
T	30,266	1,178	3,540	3.56	3,759.2	3,759.2	3,759.7	0.5
U	31,751	385	1,750	7.30	3,767.4	3,767.4	3,767.9	0.5
V	32,550	372	1,011	12.50	3,774.4	3,774.4	3,774.9	0.5
W	34,086	1,206	3,254	3.81	3,785.8	3,785.8	3,786.3	0.5
X	36,865	501	2,057	6.03	3,804.7	3,804.7	3,805.2	0.5
Y	39,065	576	2,800	4.43	3,821.1	3,821.1	3,821.6	0.5
Z	40,588	1,199	2,754	4.50	3,829.8	3,829.8	3,830.3	0.5

[1]Feet Above Confluence With Yellowstone River

TABLE 3

FEDERAL EMERGENCY MANAGEMENT AGENCY

STILLWATER COUNTY, MT
(UNINCORPORATED AREAS)

FLOODWAY DATA

STILLWATER RIVER

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
					(FEET NGVD)			
Stillwater River (Cont'd)								
AA	42,682	817	2,960	4.19	3,841.2	3,841.2	3,841.7	0.5
AB	43,737	626	2,583	4.76	3,846.9	3,846.9	3,847.4	0.5
AC	46,655	230	1,497	8.22	3,865.9	3,865.9	3,866.4	0.5
AD	48,502	413	1,794	6.86	3,879.8	3,879.8	3,880.3	0.5
AE	48,952	250	1,611	7.64	3,882.2	3,882.2	3,882.7	0.5
AF	49,409	300	1,880	6.50	3,884.4	3,884.4	3,884.9	0.5
AG	50,826	190	1,314	9.36	3,894.2	3,894.2	3,894.7	0.5
AH	52,322	400	1,976	6.22	3,903.0	3,903.0	3,903.5	0.5
AI	53,582	755	2,869	4.24	3,910.7	3,910.7	3,911.2	0.5
AJ	54,059	800	2,286	5.32	3,913.9	3,913.9	3,914.4	0.5
AK	54,894	941	2,114	5.76	3,921.8	3,921.8	3,922.3	0.5
AL	55,922	498	1,657	7.34	3,929.9	3,929.9	3,930.4	0.5
AM	58,914	230	1,628	7.48	3,948.2	3,948.2	3,948.7	0.5
AN	59,744	180	1,271	9.58	3,952.0	3,952.0	3,952.5	0.5
AO	39,844	180	1,358	8.96	3,953.2	3,953.2	3,953.7	0.5
AP	60,464	245	1,554	7.80	3,956.6	3,956.6	3,957.1	0.5
AQ	61,587	250	1,659	7.30	3,964.2	3,964.2	3,964.7	0.5
AR	62,453	354	2,135	5.70	3,969.9	3,969.9	3,970.4	0.5
AS	63,894	255	1,417	8.36	3,978.2	3,978.2	3,978.7	0.5
AT	66,170	386	1,326	8.90	3,994.4	3,994.4	3,994.9	0.5
AU	68,060	203	1,160	10.20	4,008.0	4,008.0	4,008.5	0.5
AV	70,024	210	923	12.80	4,022.2	4,022.2	4,022.7	0.5
AW	71,756	200	869	13.60	4,036.4	4,036.4	4,036.9	0.5
AX	73,110	230	1,070	11.10	4,047.8	4,047.8	4,048.3	0.5
AY	73,527	205	997	8.06	4,051.2	4,051.2	4,051.7	0.5
AZ	73,627	252	1,060	7.60	4,053.3	4,053.3	4,053.8	0.5

[1]Feet Above Confluence With Yellowstone River

TABLE 3

FEDERAL EMERGENCY MANAGEMENT AGENCY

STILLWATER COUNTY, MT
(UNINCORPORATED AREAS)

FLOODWAY DATA

STILLWATER RIVER

BEST COPY AVAILABLE

BEST COPY AVAILABLE

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
					(FEET NGVD)			
Stillwater River (Cont'd)								
BA	75,399	190	1,131	9.90	4,066.7	4,066.7	4,067.2	0.5
BB	76,732	396	1,820	6.15	4,074.8	4,074.8	4,075.3	0.5
BC	78,241	147	1,062	10.55	4,084.5	4,084.5	4,085.0	0.5
BD	79,684	204	1,258	8.90	4,094.0	4,094.0	4,094.5	0.5
BE	80,324	125	869	12.89	4,099.6	4,099.6	4,100.1	0.5
BF	80,655	742	2,301	4.87	4,102.6	4,102.6	4,103.1	0.5
BG	81,379	154	938	11.94	4,105.9	4,105.9	4,106.4	0.5
BH	81,614	95	797	14.06	4,107.3	4,107.3	4,107.8	0.5
BI	82,734	120	912	12.28	4,113.9	4,113.9	4,114.4	0.5
BJ	83,434	237	1,288	8.54	4,120.0	4,120.0	4,120.5	0.5
BK	84,534	223	1,245	8.84	4,128.1	4,128.1	4,128.6	0.5
BL	85,780	147	957	11.49	4,137.5	4,137.5	4,138.0	0.5
BM	86,306	161	991	11.10	4,142.2	4,142.2	4,142.7	0.5
BN	87,513	190	1,178	9.34	4,149.0	4,149.0	4,149.5	0.5
BO	89,140	270	1,597	6.89	4,156.8	4,156.8	4,157.3	0.5
BP	90,124	210	1,205	9.13	4,163.9	4,163.9	4,164.4	0.5
BQ	92,493	110	818	13.44	4,181.6	4,181.6	4,182.1	0.5
BR	94,141	135	977	11.26	4,190.0	4,190.0	4,190.5	0.5
BS	95,308	161	918	11.98	4,196.4	4,196.4	4,196.9	0.5
BT	96,095	176	1,154	9.53	4,202.4	4,202.4	4,202.9	0.5
BU	96,771	227	1,210	9.09	4,208.1	4,208.1	4,208.6	0.5
BV	97,572	155	965	11.40	4,213.5	4,213.5	4,214.0	0.5
BW	99,009	257	1,108	9.93	4,228.4	4,228.4	4,228.9	0.5
BX	99,562	210	1,035	10.63	4,234.2	4,234.2	4,234.7	0.5
BY	100,598	181	1,023	10.75	4,239.7	4,239.7	4,240.2	0.5
BZ	101,583	186	1,071	10.27	4,246.2	4,246.2	4,246.7	0.5

[1] Feet Above Confluence With Yellowstone River

TABLE 3

FEDERAL EMERGENCY MANAGEMENT AGENCY

STILLWATER COUNTY, MT
(UNINCORPORATED AREAS)

FLOODWAY DATA

STILLWATER RIVER

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
					(FEET NGVD)			
Stillwater River (Cont'd)								
CA	102,370	148	1,111	9.90	4,250.0	4,250.0	4,250.5	0.5
CB	103,489	131	987	11.14	4,257.9	4,257.9	4,258.4	0.5
CC	104,434	230	1,343	8.11	4,265.6	4,265.6	4,266.1	0.5
CD	105,404	175	1,499	7.20	4,273.6	4,273.6	4,274.1	0.5
CE	106,681	120	855	12.63	4,281.4	4,281.4	4,281.9	0.5
CF	107,797	215	1,139	9.48	4,290.5	4,290.5	4,291.0	0.5
CG	109,785	230	1,249	8.65	4,303.2	4,303.2	4,303.7	0.5
CH	110,559	170	1,023	10.56	4,309.8	4,309.8	4,310.3	0.5
CI	111,478	125	915	11.80	4,316.4	4,316.4	4,316.9	0.5
CJ	113,132	130	1,016	10.63	4,324.2	4,324.2	4,324.7	0.5
CK	113,958	160	1,127	9.58	4,328.8	4,328.8	4,329.3	0.5
CL	115,204	190	1,103	9.79	4,336.8	4,336.8	4,337.3	0.5
CM	117,507	163	975	11.08	4,350.4	4,350.4	4,350.9	0.5
CN	119,206	187	1,244	8.68	4,359.0	4,359.0	4,359.5	0.5
CO	120,505	152	1,038	10.41	4,367.4	4,367.4	4,367.9	0.5
CP	121,692	155	1,006	10.74	4,376.1	4,376.1	4,376.6	0.5
CQ	123,326	118	782	13.81	4,387.0	4,387.0	4,387.5	0.5
CR	124,245	180	1,219	8.86	4,393.4	4,393.4	4,393.9	0.5
CS	125,564	132	879	12.29	4,408.2	4,408.2	4,408.7	0.5
CT	127,016	201	1,223	8.50	4,419.0	4,419.0	4,419.5	0.5
CU	127,136	171	898	11.53	4,419.8	4,419.8	4,420.3	0.5
CV	128,455	140	978	10.64	4,429.9	4,429.9	4,430.4	0.5
CW	129,642	100	842	12.34	4,435.4	4,435.4	4,435.9	0.5
CX	129,750	107	1,088	9.55	4,439.0	4,439.0	4,439.5	0.5
CY	131,088	90	720	14.43	4,444.6	4,444.6	4,445.1	0.5
CZ	131,263	136	1,537	6.76	4,449.8	4,449.8	4,450.3	0.5

[1] Feet Above Confluence With Yellowstone River

TABLE 3

FEDERAL EMERGENCY MANAGEMENT AGENCY

STILLWATER COUNTY, MT
(UNINCORPORATED AREAS)

FLOODWAY DATA

STILLWATER RIVER

BEST COPY AVAILABLE

BEST COPY AVAILABLE

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
					(FEET NGVD)			
Stillwater River (Cont'd)								
DA	132,720	130	1,010	10.30	4,455.7	4,455.7	4,456.2	0.5
DB	133,757	95	738	14.09	4,464.8	4,464.8	4,465.3	0.5
DC	134,676	173	1,006	10.33	4,474.6	4,474.6	4,475.1	0.5
DD	135,843	114	774	13.43	4,487.7	4,487.7	4,488.2	0.5
DE	136,369	109	764	13.61	4,492.2	4,492.2	4,492.7	0.5
DF	136,504	99	858	12.12	4,495.8	4,495.8	4,496.3	0.5
DG	137,494	99	724	14.37	4,501.8	4,501.8	4,502.3	0.5
DH	138,020	164	892	11.66	4,507.5	4,507.5	4,508.0	0.5
DI	138,774	155	973	10.69	4,514.6	4,514.6	4,515.1	0.5
DJ	140,500	151	1,052	9.89	4,525.4	4,525.4	4,525.9	0.5
DK	142,081	118	806	12.91	4,536.6	4,536.6	4,537.1	0.5
DL	142,992	100	727	14.31	4,542.6	4,542.6	4,543.1	0.5
DM	143,838	118	808	12.87	4,550.2	4,550.2	4,550.7	0.5
DN	144,887	149	914	11.37	4,559.8	4,559.8	4,560.3	0.5
DO	146,330	163	906	11.48	4,571.7	4,571.7	4,572.2	0.5
DP	147,314	155	928	11.21	4,579.2	4,579.2	4,579.7	0.5
DQ	148,489	106	741	14.04	4,589.4	4,589.4	4,589.9	0.5
DR	149,162	110	856	12.15	4,592.8	4,592.8	4,593.3	0.5
DS	149,812	139	882	11.79	4,598.2	4,598.2	4,598.7	0.5
DT	151,446	160	1,089	9.55	4,607.5	4,607.5	4,608.0	0.5
DU	152,306	176	993	10.47	4,617.5	4,617.5	4,618.0	0.5
DV	152,436	177	1,836	5.67	4,619.5	4,619.5	4,620.0	0.5
DW	154,084	80	603	17.08	4,625.2	4,625.2	4,625.7	0.5
DX	154,209	86	845	12.18	4,631.3	4,631.3	4,631.8	0.5
DY	155,258	224	1,243	8.29	4,637.7	4,637.7	4,638.2	0.5
DZ	156,780	220	1,117	9.22	4,650.0	4,650.0	4,650.5	0.5

[1] Feet Above Confluence With Yellowstone River

TABLE 3

FEDERAL EMERGENCY MANAGEMENT AGENCY

STILLWATER COUNTY, MT
(UNINCORPORATED AREAS)

FLOODWAY DATA

STILLWATER RIVER

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
					(FEET NGVD)			
Stillwater River (Cont'd)								
EA	157,778	265	1,233	8.35	4,659.2	4,659.2	4,659.7	0.5
EB	159,465	95	739	13.94	4,670.2	4,670.2	4,670.7	0.5
EC	161,886	150	1,025	10.05	4,687.1	4,687.1	4,687.6	0.5
ED	163,250	185	1,195	8.62	4,695.7	4,695.7	4,696.2	0.5
EE	164,555	160	1,069	9.63	4,704.0	4,704.0	4,704.5	0.5
EF	166,234	185	1,121	9.19	4,711.9	4,711.9	4,712.4	0.5
EG	168,143	321	1,759	5.68	4,724.0	4,724.0	4,724.5	0.5
EH	169,338	185	1,232	8.12	4,727.8	4,727.8	4,728.3	0.5
EI	170,643	379	1,757	6.03	4,733.2	4,733.2	4,733.7	0.5
EJ	172,021	500	1,700	6.23	4,737.7	4,737.7	4,738.2	0.5
EK	172,940	185	1,105	9.05	4,744.8	4,744.8	4,745.3	0.5
EL	173,812	180	1,152	8.68	4,747.4	4,747.4	4,747.9	0.5
EM	174,166	145	1,018	9.82	4,751.1	4,751.1	4,751.6	0.5
EN	174,894	140	908	11.01	4,756.4	4,756.4	4,756.9	0.5
EO	175,347	135	1,002	9.98	4,758.6	4,758.6	4,759.1	0.5
EP	176,101	120	816	12.26	4,763.9	4,763.9	4,764.4	0.5
EQ	177,184	145	936	10.68	4,772.3	4,772.3	4,772.8	0.5
ER	177,966	145	1,009	9.91	4,777.2	4,777.2	4,777.7	0.5
ES	178,543	209	1,243	7.08	4,781.6	4,781.6	4,782.1	0.5
ET	179,395	177	1,044	8.43	4,787.4	4,787.4	4,787.9	0.5
EU	179,527	106	936	9.4	4,788.4	4,788.4	4,788.9	0.5
EV	180,669	165	1,058	8.31	4,793.6	4,793.6	4,794.1	0.5
EW	181,633	466	1,325	6.64	4,797.8	4,797.8	4,798.3	0.5
EX	182,997	228	1,649	5.34	4,801.6	4,801.6	4,802.1	0.5
EY	183,757	705	4,381	2.01	4,803.4	4,803.4	4,803.9	0.5
EZ	185,319	160	1,107	7.95	4,808.0	4,808.0	4,808.5	0.5

[1] Feet Above Confluence With Yellowstone River

BEST COPY AVAILABLE

TABLE 3

FEDERAL EMERGENCY MANAGEMENT AGENCY

STILLWATER COUNTY, MT
(UNINCORPORATED AREAS)

FLOODWAY DATA

STILLWATER RIVER

BEST COPY AVAILABLE

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
					(FEET NGVD)			
Stillwater River (Cont'd)								
FA	186,756	125	930	9.46	4,812.6	4,812.6	4,813.1	0.5
FB	188,061	365	2,313	3.80	4,816.2	4,816.2	4,816.7	0.5
FC	190,035	569	2,947	2.99	4,820.8	4,820.8	4,821.3	0.5
FD	191,334	295	1,200	7.34	4,826.0	4,826.0	4,826.5	0.5
FE	191,984	437	2,280	3.86	4,827.6	4,827.6	4,828.1	0.5
FF	192,794	220	1,079	8.06	4,828.4	4,828.4	4,828.9	0.5
FG	194,360	271	1,253	6.94	4,836.6	4,836.6	4,837.1	0.5
FH	195,850	468	2,025	4.30	4,844.5	4,844.5	4,845.0	0.5
FI	197,484	141	965	9.02	4,851.6	4,851.6	4,852.1	0.5
FJ	197,609	197	1,693	5.14	4,853.4	4,853.4	4,853.9	0.5

[1]Feet Above Confluence With Yellowstone River

TABLE 3

FEDERAL EMERGENCY MANAGEMENT AGENCY

STILLWATER COUNTY, MT
(UNINCORPORATED AREAS)

FLOODWAY DATA

STILLWATER RIVER

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
					(FEET NGVD)			
West Fork Stillwater River								
A	1,250	260	566	3.96	4,797.4	4,797.4	4,797.9	0.5
B	2,945	95	350	6.39	4,826.0	4,826.0	4,826.5	0.5
C	4,000	172	410	5.46	4,844.0	4,844.0	4,844.5	0.5
D	4,135	95	393	5.71	4,846.6	4,846.6	4,847.1	0.5
E	5,680	523	787	2.75	4,871.0	4,871.0	4,871.5	0.5
F	6,770	56	251	8.62	4,893.6	4,893.6	4,894.1	0.5
G	8,310	70	295	7.34	4,922.7	4,922.7	4,923.2	0.5
H	9,225	50	226	9.57	4,943.4	4,943.4	4,943.9	0.5
I	9,790	87	358	6.35	4,953.2	4,953.2	4,953.7	0.5
J	9,860	75	320	7.10	4,954.4	4,954.4	4,954.9	0.5
K	10,040	60	226	10.09	4,963.8	4,963.8	4,964.3	0.5
L	10,500	122	462	4.92	4,969.4	4,969.4	4,969.9	0.5
M	11,040	85	314	7.24	4.978.2	4,978.2	4,978.7	0.5
N	12,450	53	244	9.33	5,013.2	5,013.2	5,013.7	0.5
O	13,570	35	193	11.81	5,037.0	5,037.0	5,037.5	0.5
P	14,900	67	295	7.72	5,062.7	5,062.7	5,063.2	0.5
Q	15,080	68	306	7.44	5,066.4	5,066.4	5,066.9	0.5
R	15,990	55	202	9.51	5,093.5	5,093.5	5,094.0	0.5
S	17,675	97	270	7.14	5,137.0	5,137.0	5,137.0	0.5
T	19,657	55	218	8.9	5,191.9	5,191.9	5,192.4	0.5
U	20,657	94	329	5.9	5,218.1	5,218.1	5,218.6	0.5
V	21,590	225	283	6.8	5,251.2	5,251.2	5,251.7	0.5
W	23,103	78	281	6.9	5,296.7	5,296.7	5,297.2	0.5
X	24,703	81	277	7.0	5,350.0	5,350.0	5,350.5	0.5
Y	26,150	101	305	6.2	5,403.3	5,403.3	5,403.8	0.5
Z	26,257	116	480	4.0	5,406.0	5,406.0	5,406.5	0.5

[1]Feet Above Confluence With Stillwater River

BEST COPY AVAILABLE

TABLE 3

FEDERAL EMERGENCY MANAGEMENT AGENCY

STILLWATER COUNTY, MT
(UNINCORPORATED AREAS)

FLOODWAY DATA

WEST FORK STILLWATER RIVER

BEST COPY AVAILABLE

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
					(FEET NGVD)			
West Fork Stillwater River (Cont'd)								
AA	27,124	98	319	6.0	5,431.7	5,431.7	5,432.2	0.5
AB	28,791	89	295	6.5	5,491.0	5,491.0	5,491.5	0.5
AC	29,798	88	265	7.0	5,531.4	5,531.4	5,531.9	0.5
AD	30,545	39	179	10.3	5,565.7	5,565.7	5,566.2	0.5
AE	30,670	72	283	6.5	5,569.8	5,569.8	5,570.3	0.5
AF	31,203	33	170	10.8	5,592.4	5,592.4	5,592.9	0.5
AG	32,870	76	261	7.1	5,678.7	5,678.7	5,679.2	0.5
AH	34,270	77	295	6.2	5,710.5	5,710.5	5,711.0	0.5
AI	37,003	40	190	9.6	5,856.3	5,856.3	5,856.8	0.5
AJ	38,250	74	243	7.5	5,903.5	5,903.5	5,904.0	0.5
AK	38,550	98	319	5.7	5,911.3	5,911.3	5,911.8	0.5
AL	38,705	60	413	4.4	5,916.1	5,916.1	5,916.6	0.5
AM	40,405	49	241	7.5	5,946.1	5,946.1	5,946.6	0.5
AN	42,690	90	318	5.6	5,983.5	5,983.5	5,984.0	0.5

[1] Feet Above Confluence With Stillwater River

TABLE 3

FEDERAL EMERGENCY MANAGEMENT AGENCY

STILLWATER COUNTY, MT
(UNINCORPORATED AREAS)

FLOODWAY DATA

WEST FORK STILLWATER RIVER

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
					(FEET NGVD)			
West Rosebud Creek								
A	1,050	497	1,324	4.3	4,196.8	4,196.8	4,197.3	0.5
B	2,130	818	2,264	2.5	4,214.1	4,214.1	4,214.6	0.5
C	4,150	631	2,575	2.2	4,240.2	4,240.2	4,240.7	0.5
D	6,450	580	1,883	3.0	4,266.0	4,266.0	4,266.5	0.5
E	7,810	447	1,694	3.4	4,284.0	4,284.0	4,284.5	0.5
F	10,850	280	1,395	4.1	4,316.2	4,316.2	4,316.7	0.5
G	13,080	116	702	8.1	4,342.6	4,342.6	4,343.1	0.5
H	15,000	137	899	6.3	4,366.0	4,366.0	4,366.5	0.5
I	17,450	696	1,960	2.4	4,403.6	4,403.6	4,404.1	0.5
J	19,580	408	1,276	3.7	4,431.9	4,431.9	4,432.4	0.5
K	20,400	340	1,266	3.7	4,445.4	4,445.4	4,445.9	0.5
L	21,750	308	1,311	3.6	4,464.8	4,464.8	4,465.3	0.5
M	23,400	311	1,064	4.4	4,487.8	4,487.8	4,488.3	0.5
N	24,900	98	651	7.3	4,505.0	4,505.0	4,505.5	0.5
O	25,960	95	584	8.1	4,522.4	4,522.4	4,522.9	0.5
P	27,480	336	1,543	3.1	4,543.9	4,543.9	4,544.4	0.5
Q	29,030	235	1,060	4.5	4,568.9	4,568.9	4,569.4	0.5
R	31,320	167	731	6.5	4,603.8	4,603.8	4,604.3	0.5
S	33,320	199	960	4.9	4,634.8	4,634.8	4,635.3	0.5
T	35,050	80	525	9.0	4,665.7	4,665.7	4,666.2	0.5
U	40,800	114	682	6.9	4,743.3	4,743.3	4,743.8	0.5
V	42,750	374	1,373	3.4	4,767.9	4,767.9	4,768.4	0.5
W	44,590	430	1,508	3.1	4,794.5	4,794.5	4,795.0	0.5
X	45,570	245	1,060	4.5	4,812.2	4,812.2	4,812.7	0.5
Y	47,980	294	1,061	4.2	4,851.6	4,851.6	4,852.1	0.5
Z	50,300	459	1,251	3.5	4,886.0	4,886.0	4,886.5	0.5

[1]Feet Above Confluence With East Rosebud Creek and Rosebud Creek

TABLE 3

FEDERAL EMERGENCY MANAGEMENT AGENCY

STILLWATER COUNTY, MT
(UNINCORPORATED AREAS)

FLOODWAY DATA

WEST ROSEBUD CREEK

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FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
					(FEET NGVD)			
West Rosebud Creek (Cont'd)								
AA	52,180	346	1,221	3.6	4,918.7	4,918.7	4,919.2	0.5
AB	53,260	140	751	5.9	4,937.5	4,937.5	4,938.0	0.5
AC	55,700	201	788	5.6	4,967.8	4,967.8	4,968.3	0.5
AD	57,380	280	1,075	4.1	4,994.2	4,994.2	4,994.7	0.5
AE	59,980	180	856	5.2	5,025.1	5,025.1	5,025.6	0.5
AF	60,590	82	643	6.9	5,043.6	5,043.6	5,044.1	0.5
AG	62,400	76	495	7.8	5,074.9	5,074.9	5,075.4	0.5
AH	64,830	155	669	5.8	5,120.5	5,120.5	5,121.0	0.5
AI	67,100	112	629	6.1	5,164.1	5,164.1	5,164.6	0.5
AJ	69,330	267	1,171	3.3	5,208.8	5,208.8	5,209.3	0.5
AK	72,370	112	593	6.5	5,290.8	5,290.8	5,291.3	0.5
AL	74,210	120	595	6.5	5,341.6	5,341.6	5,342.1	0.5
AM	76,000	39	312	12.3	5,396.4	5,396.4	5,396.9	0.5
AN	79,150	103	599	6.4	5,477.3	5,477.3	5,477.8	0.5
AO	81,040	536	2,787	1.4	5,493.0	5,493.0	5,493.5	0.5
AP	82,420	128	852	4.5	5,499.8	5,499.8	5,500.3	0.5
AQ	84,500	229	1,106	3.5	5,514.9	5,514.9	5,515.4	0.5
AR	85,800	415	1,459	2.6	5,520.4	5,520.4	5,520.9	0.5
AS	87,400	373	1,757	2.2	5,530.4	5,530.4	5,530.9	0.5
AT	88,900	148	753	5.1	5,542.8	5,542.8	5,543.3	0.5
AU	90,010	160	875	4.4	5,551.4	5,551.4	5,551.9	0.5
AV	91,180	152	666	5.8	5,569.6	5,569.6	5,570.1	0.5
AW	92,740	168	738	5.2	5,594.3	5,594.3	5,594.8	0.5
AX	94,000	110	521	7.4	5,617.6	5,617.6	5,618.1	0.5
AY	95,340	40	295	13.1	5,673.7	5,673.7	5,674.2	0.5
AZ	96,070	128	821	4.7	5,680.2	5,680.2	5,680.7	0.5

[1] Feet Above Confluence With East Rosebud Creek and Rosebud Creek

TABLE 3

FEDERAL EMERGENCY MANAGEMENT AGENCY

STILLWATER COUNTY, MT
(UNINCORPORATED AREAS)

FLOODWAY DATA

WEST ROSEBUD CREEK

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
					(FEET NGVD)			
West Rosebud Creek (Cont'd)								
BA	97,680	309	1,416	2.7	5,687.3	5,687.3	5,687.8	0.5
BB	102,150	105	520	7.4	5,813.8	5,813.8	5,814.3	0.5

[1]Feet Above Confluence With East Rosebud Creek and Rosebud Creek

TABLE 3

FEDERAL EMERGENCY MANAGEMENT AGENCY

STILLWATER COUNTY, MT
(UNINCORPORATED AREAS)

FLOODWAY DATA

WEST ROSEBUD CREEK

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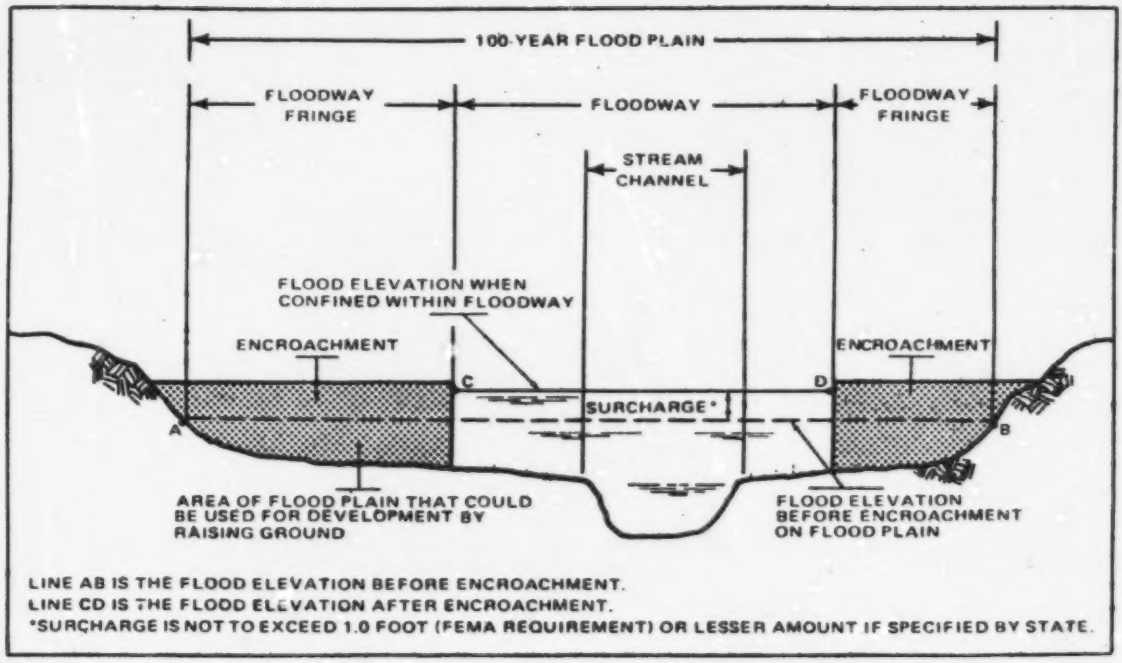
100-YEAR FLOOD PLAIN
FLOODWAY FRINGE
FLOODWAY
FLOODWAY FRINGE
STREAM CHANNEL
FLOOD ELEVATION WHEN CONFINED WITHIN FLOODWAY
ENCROACHMENT
ENCROACHMENT
C
D
SURCHARGE*
A
B
AREA OF FLOOD PLAIN THAT COULD BE USED FOR DEVELOPMENT BY RAISING GROUND
FLOOD ELEVATION BEFORE ENCROACHMENT ON FLOOD PLAIN
LINE AB IS THE FLOOD ELEVATION BEFORE ENCROACHMENT.
LINE CD IS THE FLOOD ELEVATION AFTER ENCROACHMENT.
*SURCHARGE IS NOT TO EXCEED 1.0 FOOT (FEMA REQUIREMENT) OR LESSER AMOUNT IF SPECIFIED BY STATE.

Figure 8. Floodway Schematic

5.0 INSURANCE APPLICATION

In order to establish actuarial insurance rates, the Federal Emergency Management Agency has developed a process to transform the data from the engineering study into flood insurance criteria. This process includes the determination of reaches, Flood Hazard Factors, and flood insurance zone designations for each flooding source studied in detail affecting the unincorporated areas of Stillwater County, Montana.

5.1 Reach Determinations

Reaches are defined as lengths of watercourses having relatively the same flood hazard, based on the average weighted difference in water-surface elevations between the 10- and 100-year floods. This difference does not have a variation greater than that indicated in the following table for more than 20 percent of the reach:

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Average Difference Between 10- and 100-Year Floods	Variation
Less than 2 feet	0.5 foot
2 to 7 feet	1.0 foot
7.1 to 12 feet	2.0 feet
More than 12 feet	3.0 feet

The locations of the reaches determined for the flooding sources of Stillwater County are shown on the Flood Profiles (Exhibit 1) and summarized in Table 4.

For the Side Channel West Fork Stillwater River, the reach was calculated by comparing the ground-surface elevation with the 100-year water-surface elevation.

5.2 Flood Hazard Factors

The Flood Hazard Factor (FHF) is the Federal Emergency Management Agency device used to correlate flood information with insurance rate tables. Correlations between property damage from floods and their FHF are used to set actuarial insurance premium rate tables based on FHFs from 005 to 200.

The FHF for a reach is the average weighted difference between the 10- and 100-year flood water-surface elevations expressed to the nearest one-half foot, and shown as a three-digit code. For example, if the difference between water-surface elevations of the 10- and 100-year floods is 0.7 foot, the FHF is 005; if the difference is 1.4 feet, the FHF is 015; if the difference is 5.0 feet, the FHF is 050. When the difference between the 10- and 100-year water-surface elevations is greater than 10.0 feet, accuracy for the FHF is to the nearest foot.

5.3 Flood Insurance Zones

After the determination of reaches and their respective FHFs, the entire unincorporated area of Stillwater County was divided into zones, each having a specific flood potential or hazard. Each zone was assigned one of the following flood insurance zone designations:

Zone A: Special Flood Hazard Areas inundated by the 100-year flood, determined by approximate methods; no base flood elevations shown or FHFs determined.

Zones A1-A6: Special Flood Hazard Areas inundated by the 100-year flood, determined by detailed methods; base flood elevations shown, and zones subdivided according to FHFs.

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FLOODING SOURCE	PANEL[1]	ELEVATION DIFFERENCE[2] BETWEEN 1% (100-YEAR) FLOOD AND			FLOOD HAZARD FACTOR	ZONE	BASE FLOOD ELEVATION (FEET NGVD)[3]
		10% (10-YEAR)	2% (50-YEAR)	0.2% (500-YEAR)			
Butcher Creek							
Reach 1	0630	-1.3	-0.4	0.8	015	A3	Varies - See Map
Reach 2	0630,0640	-2.3	-0.6	1.2	025	A5	Varies - See Map
East Rosebud Creek							
Reach 1	0630,0640	-1.4	-0.4	0.8	015	A3	Varies - See Map
Fiddler Creek							
Reach 1	0620	-2.0	-0.6	1.1	020	A4	Varies - See Map
Reach 2	0620,0735	-2.5	-0.8	1.4	025	A5	Varies - See Map
Fishtail Creek							
Reach 1	0610,0615 0620	-1.7	-0.5	1.1	015	A3	Varies - See Map
Ingersoll Creek							
Reach 1	0620,0735	-2.9	-0.9	2.1	030	A6	Varies - See Map
Rosebud Creek							
Reach 1	0511,0512 0513,0630	-1.19	-0.33	0.65	010	A2	Varies - See Map
Sheep Creek							
Reach 1	0512,0513 0514	-0.77	-0.41	1.64	010	A2	Varies - See Map

[1]Flood Insurance Rate Map Panel [2]Weighted Average [3]Rounded to Nearest Foot

TABLE 4

FEDERAL EMERGENCY MANAGEMENT AGENCY

STILLWATER COUNTY, MT
(UNINCORPORATED AREAS)

FLOOD INSURANCE ZONE DATA

BUTCHER CREEK-EAST ROSEBUD CREEK-FIDDLER CREEK-FISHTAIL CREEK-INGERSOLL CREEK-ROSEBUD CREEK-SHEEP CREEK

FLOODING SOURCE	PANEL[1]	ELEVATION DIFFERENCE[2] BETWEEN 1% (100-YEAR) FLOOD AND			FLOOD HAZARD FACTOR	ZONE	BASE FLOOD ELEVATION (FEET NGVD)[3]
		10% (10-YEAR)	2% (50-YEAR)	0.2% (500-YEAR)			
Side Channel West Fork Stillwater River Reach 1	0583,0584 0592	-2.3	-0.6	0.2	025	A5	Varies - See Map
Stillwater River Reach 1	0394,0489 0491,0492 0493,0494 0506,0507 0508,0511 0512,0513 0516,0584 0591,0592 0601,0602 0603	-0.9	-0.3	0.6	010	A2	Varies - See Map
West Fork Stillwater River Reach 1	0579,0583 0584,0587 0592	-0.7	-0.2	0.4	005	A1	Varies - See Map
West Rosebud Creek Reach 1	0610,0620 0630,0735 0745	-1.7	-3.2	1.1	015	A3	Varies - See Map

[1]Flood Insurance Rate Map Panel [2]Weighted Average [3]Rounded to Nearest Foot

TABLE 4

FEDERAL EMERGENCY MANAGEMENT AGENCY

STILLWATER COUNTY, MT
(UNINCORPORATED AREAS)

FLOOD INSURANCE ZONE DATA

SIDE CHANNEL WEST FORK STILLWATER RIVER-STILLWATER RIVER-WEST FORK STILLWATER RIVER-WEST ROSEBUD CREEK

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Zone B:	Areas between the Special Flood Hazard Areas and the limits of the 500-year flood, including areas of the 500-year flood plain that are protected from the 100-year flood by dike, levee, or other water-control structure; also areas subject to certain types of 100-year shallow flooding where depths are less than 1.0 foot; and areas subject to 100-year flooding from sources with drainage areas less than 1 square mile. Zone B is not subdivided.
Zone C:	Areas of minimal flooding.
Zone D:	Areas of undetermined, but possible flood hazard.

The flood elevation differences, FHFs, flood insurance zones, and base flood elevations for each flooding source studied in detail in the county are summarized in Table 4.

5.4 Flood Insurance Rate Map Description

The Flood Insurance Rate Map for Stillwater County is, for insurance purposes, the principal result of the Flood Insurance Study. This map (published separately) contains the official delineation of flood insurance zones and base flood elevation lines. Base flood elevation lines show the locations of the expected whole-foot water-surface elevations of the base (100-year) flood. This map is developed in accordance with the latest flood insurance map preparation guidelines published by the Federal Emergency Management Agency.

6.0 OTHER STUDIES

A Flood Insurance Study has been published for the unincorporated areas of Carbon County, Montana (Reference 15), which includes approximate studies of East Rosebud Creek and Yellowstone River at the Stillwater-Carbon County line. There are discrepancies between the Carbon County study and the Stillwater County study. These discrepancies involve Butcher Creek, East Rosebud Creek, Ingersoll Creek, and Antelope Creek where the streams cross the county border. These discrepancies have been documented and the Carbon County Flood Insurance Study will be revised accordingly.

A Flood Insurance Study has been published for the unincorporated areas of Yellowstone County, Montana (Reference 16), and includes a detailed study of Yellowstone River at the Stillwater-Yellowstone County line.

A Flood Insurance Study has been published for the unincorporated areas of Sweet Grass County, Montana (Reference 17), and includes an approximate study of Yellowstone River at the Stillwater-Sweet Grass County line.

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A Flood Insurance Study has also been published for Golden Valley County, Montana (Reference 18); however, none of the study reaches are adjacent to Stillwater County.

The Rosebud and Sheep Creek study reaches were previously studied by the SCS in a Flood Hazard Analyses report released in May 1974 (Reference 3). The SCS studied Rosebud Creek from its confluence with Stillwater River through the Town of Absarokee to the confluence of East and West Rosebud Creeks. The report delineated a 100-year flood plain on Sheep Creek from its confluence with Stillwater River to the west end of Willow Street in Absarokee; however, a flood profile was not included for this reach. Rosebud Creek experienced significant floods in June 1974 and June 1975 which caused changes in the channel through the Town of Absarokee. (The right (east) bank along this reach has been heavily riprapped to protect it from the high velocities of floodflows in Rosebud Creek.) Because of the changes in the Rosebud Creek channel through Absarokee, the lack of a Sheep Creek profile in a previous SCS report (Reference 3), and the revised hydrology, additional field survey information for this Flood Insurance Study was obtained and hydraulic analyses were undertaken to verify the flood plains of these streams.

East Rosebud, West Rosebud, Butcher, Fishtail, Fiddler, and Ingersoll Creeks were previously studied by the SCS in a Flood Hazard Analyses report (Reference 9) released in August 1975. Because the revised hydrology reflects larger flood discharges, it was necessary to reevaluate the corresponding effects on the water-surface profiles and flood plain boundaries. Copies of the channel cross section plots and WSP-2 computer printouts used in the previous study by the SCS were obtained for this study in order to determine the revised profiles and delineations. The WSP-2 output is in the form of stage-discharge curves for each cross section from which water-surface elevations can be determined for any discharge.

The SCS also developed a regional analysis for the Stillwater River tributaries (Reference 3) which agreed with this study for drainage areas greater than 400 square miles. The SCS regional hydrology was generally low for drainage areas less than 400 square miles and was not used in this report. Several factors have caused this difference, but probably the most influential one is the additional years of record available at all gaging sites since the original SCS hydrology was completed in 1973. Most of the smaller drainage area sites had short terms of record. All of the Stillwater River drainages experienced major floods in 1974 and 1975 which caused a considerable shift from the 1973 SCS log-Pearson results to the 1978 log-Pearson results.

The Stillwater River and Rosebud Creek Flood Hazard Analyses report was published in May 1974 (Reference 3) and studied Stillwater River from its confluence with Yellowstone River to a point near the Town of Absarokee. The first printing of this report did not contain a flood-

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way delineation though a limited number of copies were later printed containing a floodway delineation.

The Upper Stillwater River and West Fork Stillwater River Flood Hazard Analyses report was published in January 1979 (Reference 4) and analyzed Stillwater River from Absarokee to the Custer National Forest boundary and the West Fork from its confluence with the main stem to the Custer National Forest boundary.

A supplementary study was done on West Fork Stillwater River which added 4.6 miles to the study reach (Reference 19).

A Flood Hazard Boundary Map was prepared for Stillwater County, Montana (Reference 14). This study represents a more detailed analysis and therefore supersedes it.

This study is authoritative for the purposes of the National Flood Insurance Program; data presented herein either supersede or are compatible with all previous determinations.

7.0 LOCATION OF DATA

Information concerning the pertinent data used in preparation of this study can be obtained by contacting the Natural and Technological Hazards Division, Federal Emergency Management Agency, Building 710, Denver Federal Center, Lakewood, Colorado 80225.

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